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ADDENDUM TO

F.A. REPORT NO. R 1184

O.O. Project No. TA1 5003

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October 1954

Artillery Ammunition Department Frankford Arsenal, Philadelphia, Pa.

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ADDENDUM TO
F.A. REPORT NO. R-1184
O. O. PROJECT NO. TA1-5003

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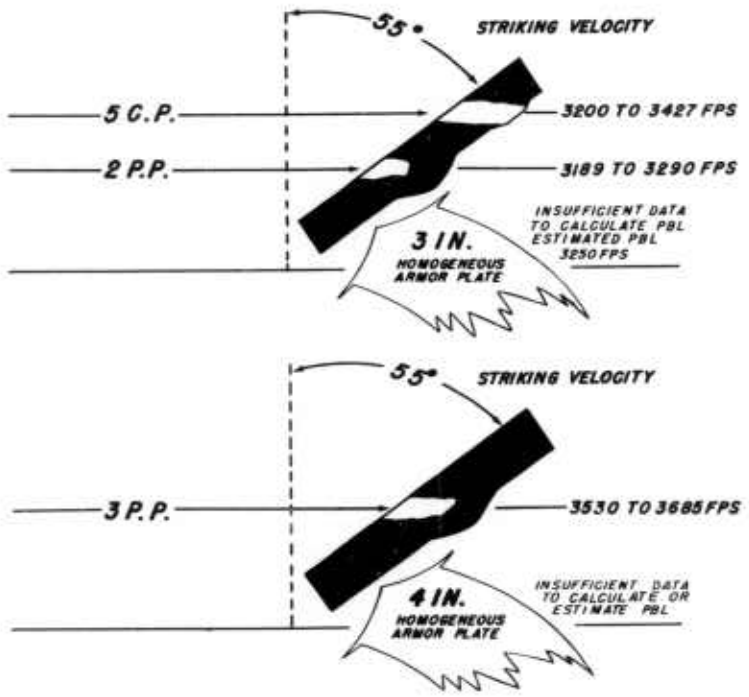
ADDENDUM TO REPORT R-1148

Section IV, page 5, of the original report lists several conclusions drawn from data available at the time of its preparation. In view of the fact that the data on which these conclusions were based appears rather scanty, it is the intention at this time (1) to present the data in question, and (2) to present additional data obtained since the publication of that report. Such conclusions as presently appear reasonable will be briefly discussed.

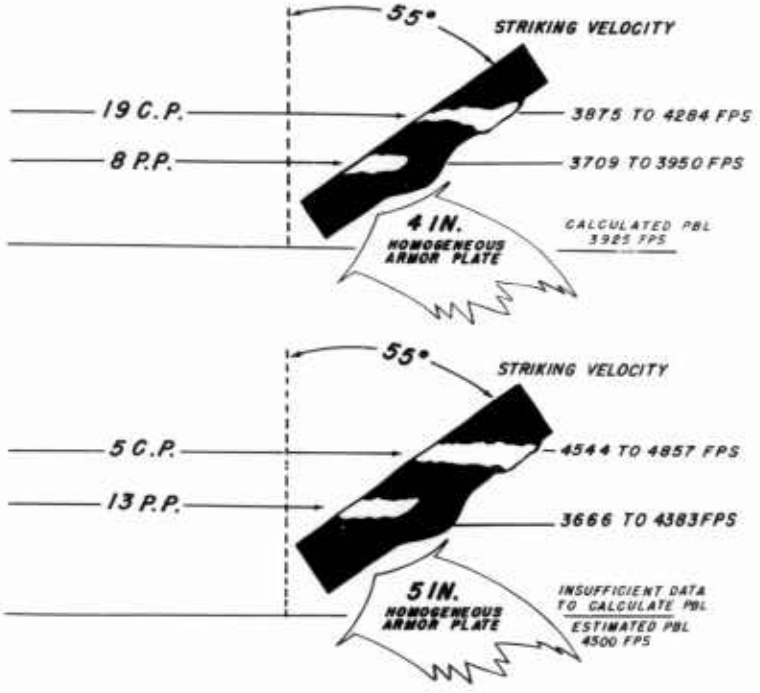
90MM T82E16 AP DS SHOT

Table I is a tabulation of all T82E16 projectiles fired. Below is a summary of the penetration data as presented in this tabulation through August 1954:

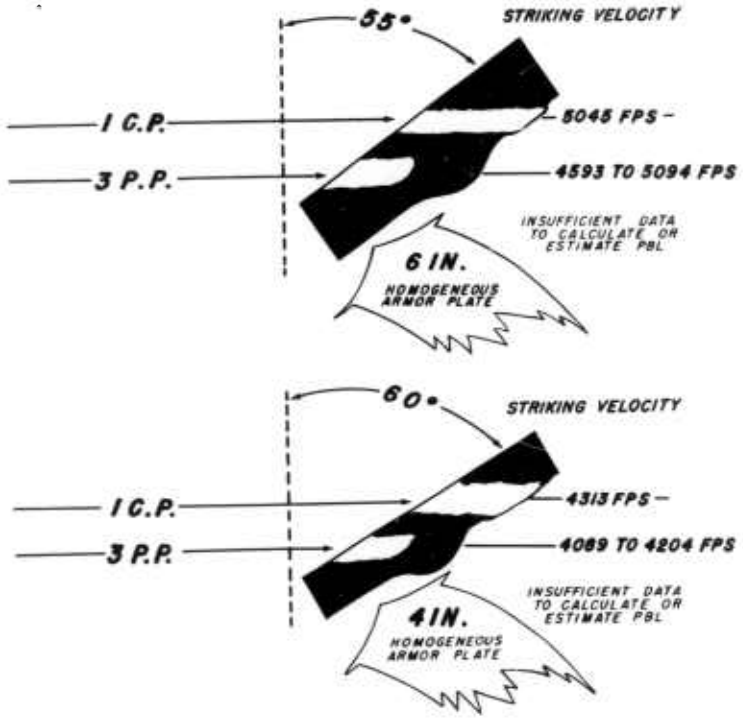


90MM T82E22 AP DS SHOT

Table II is a tabulation of all T82E22 projectiles fired through August 1954 which includes firings that took place during a demonstration at APG for the members of the General Staff and interested AFF personnel in July of 1954. Below is a summary of the data as presented in this tabulation:



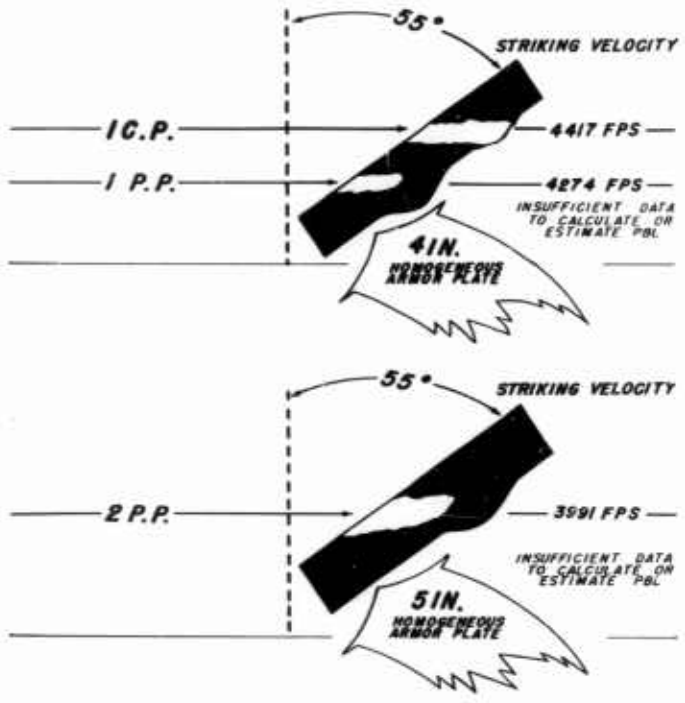
90MM T82E22 AP DS SHOT CONT.



90MM T82E23 AP DS SHOT

Table III is a tabulation of all T82E23 projectiles fired through August 1954.

Below is a summary of the data as presented in this tabulation:



ANALYSIS OF EXISTING DATA

In analyzing the preceeding data, it can be seen that only one PBL has been established in accordance with standard practice for determining the PBL of armor plate. Since more firings have taken place with the T82E22 than either of the other types, the only reasonable estimates of required muzzle velocities must be based upon these firings. For a 4" target at 55°, a PBL of 3925 ft/sec has been obtained. For a 5" target at 55°, a PBL of 4500 ft/sec has been estimated. Taking into consideration the drop off in velocity of the T82E22 at 2000 yards, it is estimated that a muzzle velocity of 4600 ft/sec would be required to defeat the 4" target at 55°, and 5400 ft/sec would be required to defeat the 5" target at 55° with the existing design. Presumably, these velocities can be lowered by streamlining the projectile nose to reduce the drop off.

It is not meaningful to make an estimate for the 6" target at 55° because of the paucity of data for this particular target.

Because of the limited number of rounds fired of the T82E16 and T82E23 designs, it is premature to rule out either design as being inferior to the T82E22. It does appear that the T82E22 might be superior to the T82E23 for a particular target, namely, 4" at 55°, but against thicker targets at higher angles of obliquity much more data would be required in order to draw any valid conclusions concerning the three (3) designs.

DISCUSSION OF PROJECTILE PERFORMANCE FROM THE DATA WHICH HAS BEEN MADE AVAILABLE

It appears that an arrow projectile is superior to a standard projectile fired from a rifled gun. This superiority is significant. This superiority is in both the terminal ballistic effect and in the fact that the projectile is fired at a higher velocity, which should improve the probability of first round hit. It also appears that the performance of present arrow projectiles can be significantly improved upon, whereas, it does not appear that rotated projectiles can be significantly improved upon by changing shape, metallurgy, etc. It further appears that arrow projectiles will not fail at particular ranges because of a phenomenon known as "shatter" in projectiles. This phenomenon was brought to light in developing standard spin stabilized projectiles. Where the "shatter gap" exists, a shell will defeat armor plate at a certain velocity level; at a higher velocity it will fail to defeat armor because the shell breaks up; at a still higher velocity the standard shell will get through the armor plate despite the fact that the shell breaks up. The arrow shell breaks up in penetrating armor, but the so-called "shatter gap" area of ineffectiveness does not appear, since the velocity level is well above that of the "shatter gap".

TABLE I

T82E16 PLATE PENETRATION TESTS

GUN TYPE	TUBE	CART CASE TYPE	PROPELLIANT			CHAMBER PRES. PSIx100	PROJ. TOTAL WT-LBS	STRIK-ING VEL. FPS	PLATE DATA				RANGE	PENETRA-TION
			TYPE	WEB-IN	WT.-LBS&OZ				NUMBER	THICK-NESS-IN.	OBLIQ-UITY-°	B.H.N.		
M3A1 #890	90mm M3 Smooth-bore #693690		MP-M6	.043	7-0	337	14.22	3189	099504-A	3"	55°	285	100 yds	PP
"	"		"	"	7-8	425	14.26	3427	"	"	"	"	"	CP
"	"		"	"	7-4	-	14.28	3290	"	"	"	"	"	PP
"	"		"	"	7-6	-	14.25	Lost	"	"	"	"	"	CP
"	"		"	"	7-6	-	14.26	3343	"	"	"	"	"	CP
"	"		"	"	7-2	-	14.29	3261	"	"	"	"	"	CP
"	"		"	"	7-0	-	14.28	3200	"	"	"	"	"	CP
"	"		"	"	8-0	516	14.27	3685	015443-A3	4"	"	308	"	PP
"	"		"	"	7-12	-	14.30	3530	"	"	"	"	"	PP
"	"		"	"	8-0	-	14.27	3644	"	"	"	"	"	PP

TABLE II

T82E22 PLATE PENETRATION TESTS

GUN TYPE	TUBE	CART CASE TYPE	PROPELLANT			CHAMBER PRES. PSIx100	PROJ. TOTAL WT-LBS	STRIKING VEL. FPS	PLATE DATA				RANGE	PENETRATION
			TYPE	WEB-IN	WT.-LBS&OZ				NUMBER	THICKNESS-IN.	OBLIQUITY-°	B.H.N.		
M3A1 #890	90mm M3 #693690	T27 or T14	MP-M17	.0479	7-8	374	11.11	3935	015440-A2	4"	55°	308	100 yds	CP
"	"	"	"	"	7-4	390	11.12	3923	"	"	"	"	"	PP
"	"	"	"	"	7-6	-	11.08	3875	"	"	"	"	"	CP
"	"	"	"	"	7-2	-	11.08	3727	"	"	"	"	"	PP
"	"	"	"	"	7-5	-	11.10	3814	"	"	"	"	"	PP
"	"	"	"	"	7-7	-	11.13	4017	"	"	"	"	"	CP
"	"	"	"	"	7-4	-	11.09	3862	"	"	"	"	"	Bad Hit
"	"	"	"	"	7-3	-	11.06	3850	"	"	"	"	"	PP
"	"	"	"	"	7-6	-	11.04	3950	"	"	"	"	"	PP
"	"	"	"	"	7-5	-	11.08	Lost	"	"	"	"	"	--
"	"	"	"	"	8-4	534	11.09	4360	015700-B1	5"	55°	285	"	PP
"	"	"	"	"	8-8	561	11.09	4443	"	"	"	"	"	PP
"	"	"	"	"	8-4	524	11.08	Lost	"	"	"	"	"	PP
"	"	"	"	"	8-0	508	11.02	Lost	"	"	"	"	"	PP
"	"	"	"	.0454	8-4	566	11.09	Lost	"	"	"	"	"	PP
T114 #1	90mm T114 #38476	"	"	.0570	12-0	180	11.02	3666	"	"	"	"	"	PP
"	"	"	"	"	16-0	398	11.05	4857	"	"	"	"	"	CP
"	"	"	"	"	15-4	312	11.01	4230	"	"	"	"	"	Bad Hit
"	"	"	"	"	"	-	11.08	4546	015700-B1	"	"	"	"	CP
"	"	"	"	"	15-0	-	11.04	4383	"	"	"	"	"	PP
"	"	"	"	"	15-8	-	11.03	Lost	"	"	"	"	"	PP
"	"	"	"	"	15-10	-	11.04	4275	"	"	"	"	"	PP
"	"	"	"	"	16-6	377	11.05	4544	"	"	"	"	"	CP
"	"	"	"	"	16-3	-	11.02	4123	"	"	"	"	"	PP
"	"	"	"	"	16-3	-	9.25	Lost	"	"	"	"	"	Miss
"	"	"	"	"	16-3	-	11.04	2720	"	"	"	"	"	PP

TABLE II CONT.
T82E22 PLATE PENETRATION TESTS

GUN TYPE	TUBE	CART CASE TYPE	PROPELLANT			CHAMBER PRES. PSIx100	PROJ. TOTAL WT-LBS	STRIKING VEL. FPS	PLATE DATA				RANGE	PENETRATION
			TYPE	WEB-IN	WT.-LBS&OZ				NUMBER	THICKNESS-IN.	OBLIQUITY-°	B.H.N.		
M3A1 #891	90mm M3 #693690 Smooth	T27 or T14	MP-M17	.0454	8-4	494	10.34	4301	015700-B1	5"	55°	285	100 yds	PP
"	"	"	"	.0454	4-4	402	9.28	Lost	"	"	"	"	"	Miss
"	"	"	"	.0570	4-4									
"	"	"	"	"	"	434	10.33	3929	"	"	"	"	"	PP
T114 #1	90mm T114 #38476	"	"	.0570	16-8	489	11.06	4593	14051-1	6"	"	245	"	PP
"	"	"	"	"	16-12	396	11.08	4698	"	"	"	"	"	PP
"	"	"	"	"	17-8	520	11.10	5049	"	"	"	"	"	PP
"	"	"	"	"	17-14	-	11.10	Lost	"	"	"	"	"	Bad Hit
"	"	"	"	"	18-0	-	11.08	Lost	"	"	"	"	"	Miss
"	"	"	"	"	17-12	497	11.08	5045	"	"	"	"	"	CP
"	"	"	"	"	17-13	-	11.02	Lost	01413-2	10"	30°	209	"	Miss
"	"	"	"	"	17-8	-	11.13	Lost	"	"	"	"	"	Miss
"	"	"	"	"	17-0	-	11.11	Lost	"	"	"	"	"	Miss
"	"	"	"	"	16-8	-	11.12	Lost	"	"	"	"	"	Miss
M3A1	90mm M3 #693690	"	"	.0479	7-14	454	11.00	4089	046380-A	4"	60°	285	"	PP
"	"	"	"	"	8-2	482	11.04	4204	"	"	"	"	"	PP
"	"	"	"	"	8-4	536	11.01	4313	"	"	"	"	"	CP
"	"	"	"	"	8-0	476	11.03	4139	"	"	"	"	"	PP
"	"	"	"	"	8-2	570	11.01	Lost	"	"	"	"	"	CP
"	"	"	"	"	8-0	-	11.00	4156	14029-1	8"	30°	243	"	PP
"	"	"	"	"	8-2	500	11.00	4302	"	"	"	"	"	PP
"	"	"	"	"	8-0	-	11.00	4196	"	"	23°	"	"	PP
"	"	"	"	"	8-0	-	11.01	4202	"	"	0°	"	"	PP
"	"	"	"	"	8-0	-	11.01	4210	14058-2	7"	0°	246	"	PP
"	"	"	"	"	8-2	-	11.01	4224	"	"	"	"	"	PP
"	"	"	"	"	8-0	-	11.01	4145	14067-1	6"	"	237	"	CP

TABLE II CONT.

T82E22 PLATE PENETRATION TESTS

GUN TYPE	TUBE	CART CASE TYPE	PROPELLANT TYPE	PROPELLANT WEB-IN	PROPELLANT WT.-LBS&OZ	CHAMBER PRES. PSIx100	PROJ. TOTAL WT-LBS	STRIKING VEL. FPS	PLATE DATA NUMBER	PLATE DATA THICKNESS-IN.	PLATE DATA OBLIQUITY-°	PLATE DATA B.H.N.	RANGE	PENETRATION
M3A1	90mm M3 #693690		MP-M17	.0479	7-13	-	11.01	4104	14067-1	6"	0°	237	100 yds	CP
"	"		"	"	7-9	-	11.02	3921	"	"	"	"	"	CP
"	"		"	"	7-5	-	11.00	3632	"	"	"	"	"	Bad Hit
M3A1	90mm M3		"	"	7-5	-	11.00	3819	"	"	"	"	"	PP
	90mm T114 Smoothbore													
105mm T140E2 #9	105mm T210 #122		"	.0613	17-0	484	10.66	Lost	067294-A1	5"	65°	277	"	Miss
"	"		"	"	16-8	470	13.42	5082	"	"	"	"	"	PP
"	"		"	"	16-8	420	10.66	Lost	"	"	"	"	"	Miss
"	"		"	.0787	18-0	394	13.42	4719	"	"	"	"	"	PP
"	"		"	.0613	16-0	492	13.42	Lost	046381-A	4"	"	293	"	Miss
"	"		"	"	16-0	431	13.42	Lost	"	"	"	"	"	Miss
"	"		"	"	16-0	440	13.42	Lost	"	"	"	"	"	PP
90mm T139	90mm T209 #75383		"	"	7-5	412	11.10	3993	050559	4"	55°	302	"	CP
"	"				7-9	-	11.02	3867	"	"	"	"	"	CP
"	"				7-5	-	11.00	4001	"	"	"	"	"	CP
"	"				7-5	-	11.00	3709	"	"	"	"	"	PP
"	"				7-7	-	11.00	3846	"	"	"	"	"	PP
90mm T139 #243	90mm T209 #75383		MP-M17	.0479	7-14	454	11.29	Lost	0119215	4"	"	255	500 yds	PP
"	"		"	"	8-2	478	11.36	4099	"	"	"	"	"	Bad Hit
"	"		"	"	8-2	560	11.10	Lost	"	"	"	"	"	CP
"	"		"	"	7-14	480	11.07	Lost	"	"	"	"	"	CP
"	"		"	"	7-15	489	11.07	Lost	"	"	"	"	"	CP
"	"		"	"	7-14	478	11.12	Lost	"	"	"	"	"	CP

TABLE II CONT.

T82E22 PLATE PENETRATION TESTS

GUN TYPE	TUBE	CART CASE TYPE	PROPELLANT TYPE	PROPELLANT WEB-IN	PROPELLANT WT.-LBS&OZ	CHAMBER PRES. PSIx100	PROJ. TOTAL WT-LBS	STRIKING VEL. FPS	PLATE DATA NUMBER	PLATE DATA THICKNESS-IN.	PLATE DATA OBLIQUITY-°	PLATE DATA B.H.N.	RANGE	PENETRATION
105mm T140E2 #9	105mm T210 #120 Smooth		HPC-38317		16-8	467	13.42	Not Taken.	026752	5"	55°	285	500 yds	CP
"	"		"		17-0	492	13.22	"	"	"	"	"	"	CP
90mm T139 #243	90mm T209 #75383		MP-M17	.0479	7-15	-	11.10	4284	050558	4"	"	302	"	CP
"	"		"	"	"	-	11.10	Lost	"	"	"	"	"	CP
"	"		"	"	"	-	11.10	Lost	"	"	"	"	"	CP
"	"		"	"	"	-	11.10	Not Taken.	Tank Hull Glacis.	3-3/8"	"	322	"	Miss
"	"		"	"	"	-	11.10	"	"	"	"	"	"	CP
105mm T140E2 #9	105mm T210 #122		HPC-38317		17-0	-	13.42	"	048578	4.7"	49° / 36°	285	"	CP
90mm T139 #243	90mm T209 #75383		MP-M17	.0479	7-15	-	11.10	MV 4257	050558	4"	55°	302	"	CP
"	"		"	"	"	-	11.10	MV 4255	"	"	"	"	"	CP
"	"		"	"	"	-	11.10	Lost	"	"	"	"	"	CP
"	"		"	"	"	-	11.10	Lost	Tank Hull	3-3/8"	"	"	"	CP
105mm T140E2 #9	105mm T210 #122		HPC-38317		17-0	-	13.42	Lost	048578	4.7"	49° / 36°	285	"	Bad Hit
90mm T139 #243	90mm T209 #75383		MP-M17	.0479	7-15	-	11.10	4028	Striking Velocity Check Only					
"	"		"	"	"	-	11.10	4040	"	"	"	"		
"	"		"	"	"	-	11.10	3988	"	"	"	"		

TABLE II CONT.

T82E22 PLATE PENETRATION TESTS

GUN TYPE	TUBE	CART CASE TYPE	PROPELLANT			CHAMBER PRES. PSIx100	PROJ. TOTAL WT-LBS	STRIKING VEL. FPS	PLATE DATA				RANGE	PENETRATION
			TYPE	WEB-IN	WT.-LBS&OZ				NUMBER	THICKNESS-IN.	OBLIQUITY-°	B.H.N.		
90mm T139 #243	90mm T209 #75383		MP-M17	.0479	7-15	-	11.10	4072	050559	4"	55°	302	500 yds	CP
"	"		"	"	"	-	11.10	4056	"	"	"	"	"	CP
"	"		"	"	"	-	11.10	4056	"	"	"	"	"	CP
"	"		"	"	"	-	11.10	Lost	Upper Tank Hull	3-3/8"	"	322	"	CP
"	"		"	"	"	-	11.10	4053	"	"	"	"	"	CP
"	"		"	"	"	-	11.10	Lost	Lower Tank Hull	"	"	"	"	CP
105mm T140E2 #9	105mm T210 #122		HPC-38317		17-0	-	13.42	5013	048578	4.7"	49°/36°	285	"	CP
"	"		"		"	-	13.42	Lost	"	"	"	"	"	Miss
"	"		"		"	-	13.42	Lost	"	"	"	"	"	Miss
"	"		"		"	-	13.42	Lost	"	"	"	"	"	CP

TABLE III

T82E23 PLATE PENETRATION TESTS

GUN TYPE	TUBE	CART CASE TYPE	PROPELLANT			CHAMBER PRES. PSIx100	PROJ. TOTAL WT-LBS	STRIKING VEL. FPS	PLATE DATA				RANGE	PENETRATION
			TYPE	WEB-IN	WT.-LBS&OZ				NUMBER	THICKNESS-IN.	OBLIQUITY-°	B.H.N.		
90mm M3A1 #890	90mm M3 #693690	T27 or T14	MP-M17	.0479	7-8	-	9.97	Lost	015440-A2	4"	55°	308	100 yds	PP
"	"	"	"	"	8-0	-	9.97	Lost	"	"	"	"	"	PP
"	"	"	"	"	8-4	-	10.00	Lost	"	"	"	"	"	CP
"	"	"	"	"	8-3	-	10.00	4417	"	"	"	"	"	CP
"	"	"	"	"	8-0	-	9.97	4274	"	"	"	"	"	PP
"	"	"	"	.0454	7-8	368	9.98	3991	015700-B1	5"	"	285	"	PP
"	"	"	"	"	8-4	514	9.96	4411	"	"	"	"	"	PP
90mm T114 #1	90mm T114 #38476	"	"	.0570	17-13	-	9.98	Lost	01413-2	10"	30°	209	"	PP
"	"	"	"	"	17-8	515	9.95	5292	"	"	"	"	"	PP

Unclassified